

3.2.1 AFCEE Requirements for Development and Application of Conceptual Site Models

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Introduction

A conceptual site model (CSM) (sometimes called a conceptual model) is a written and/or pictorial representation of an environmental system. CSMs describe the biological, physical, and chemical processes that determine the transport of contaminants from sources through environmental media to environmental receptors that could potentially be affected by exposure to the contaminants. CSMs are used to integrate technical information, identify data needs, establish reference areas for collecting information on the background concentrations of chemicals, and develop working hypotheses or questions about how exposures might affect receptors. These functions of CSMs make them critical elements of all risk assessment work plans, reports, and briefings. For the purpose of this note, a site is defined as the entity on which remedial decisions will be made.

AFCEE Requirements

Once a preliminary assessment/site inspection, a RCRA facility assessment, or a National Priority List evaluation has been conducted for a site, there should be sufficient information to develop an initial CSM. Site-specific CSMs must be provided in the work plans for each subsequent investigative effort and they must be used to technically justify the efforts delineated in the work plans. Site-specific CSMs must be revised to integrate the technical information generated by these investigations and the revised CSMs must be used to interpret the risk assessments conducted for each site. Site-specific CSMs are required for the following activities:

- Integration and presentation of site information at all Scientific/Management Decision Points
- Development and justification of investigation work plans
- Integration of risk assessment information in remedial investigation reports
 - Interpretation of the risk assessments
 - Evaluation of the uncertainty of the risk assessments
- Evaluation of remedial alternatives

Recommended Practices and Guidance

An outline of the overall process for developing a CSM is provided in Exhibit 6 of the Guidance for Data Usability in Risk Assessment (U.S. EPA, 1992). Greater detail on the information that is included in human health and ecological CSMs can be found in a variety of guidance documents and open literature publications (e.g., ASTM, 1995; Suter, 1999; U.S. EPA, 1989; 1996). Once the necessary information is available, the means of presenting the CSM must be addressed. The type of presentation used is governed by the complexity of the site and the audience to whom the CSM will be presented. The

audience may not be limited to environmental professionals and may include the general public.

There is no single best way to present the CSM, and the method may vary with the specific purpose of the document or the briefing in which it is imbedded. The most useful way to present the CSM is with a combination of text, figures, flow charts, and tables (ASTM, 1995). The CSM for each site includes maps that accurately identify the location of the source and depict the boundaries of the base, as well as other sites and sources, residential areas, wetlands, and other areas where potential receptors may be found.

A CSM evolves as the Environmental Restoration Program (ERP) efforts for a site progress. In the ERP process, a CSM is used as a communication tool to integrate site information, clarify assumptions, and pose questions to be answered by the risk assessments for the site. Developing the CSM compels the risk assessor to work with the risk managers to justify their assumptions and develop questions that need to be answered concerning source areas, exposure pathways, and receptors. The CSM is then used to justify and focus additional investigations in a work plan. It also provides the framework for the risk assessment and its uncertainty analysis.

CSMs are used to demonstrate that a proposed source characterization effort will provide information that (1) is both sufficient and relevant for the site risk assessments and (2) meets the data quality objectives. Following the source characterization effort, the CSM is updated to incorporate the information developed by the investigation. When source characterization information is integrated into the CSM, an evaluation is provided of whether the source of contamination has been sufficiently characterized to support the site risk assessments.

The CSM includes an evaluation of all potential pathways. For each pathway, a technical case is developed to designate the pathway as complete, incomplete, negligible, or insufficiently characterized. For those pathways that are complete, information is provided that supports its description as a major or a minor contributor to the current or the potential future exposure of each receptor. In considering ecological receptors, the food web that may result in exposure of higher trophic level receptors to site contaminants is delineated in sufficient detail to make the case for pathways being complete, incomplete, negligible, or insufficiently characterized.

All potential receptors are included in the CSM. The information on the exposure pathways is used as the basis for determining whether each receptor is or is not exposed. Cases supporting the exposure or non-exposure are presented for both current and future human health and ecological receptors, as appropriate for the site.

Ecological risk assessment CSMs differ from human-health risk assessment CSMs predominantly in the description of the receptors. A variety of ecological receptors can be delineated in a generalized (human-health and ecological) CSM. In an ecological risk assessment CSM, the exposure pathways must be directly linked to the assessment endpoints—the ecological attributes that are to be protected (U.S. EPA, 1997). The CSM

serves as the foundation for the selection of measurement endpoints and for the sampling and analysis plan developed for the baseline ecological risk assessment.

References

ASTM. 1995. *Standard Guide for Developing Conceptual Site Models for Contaminated Sites*. American Society for Testing and Materials: E 1689–95.

Suter, G. W. 1999. “Developing Conceptual Models for Complex Ecological Risk Assessments,” *Human and Ecological Risk Assessment*. (5)2: 375–396.

U.S. EPA. 1989. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A Baseline Risk Assessment, Interim Final (RAGS, Part A)*. U.S. Environmental Protection Agency: EPA/540/1-89/002.

U.S. EPA. 1992. *Guidance for Data Usability in Risk Assessment (Part A)*. U.S. Environmental Protection Agency: 9285.7-09A/FS.

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